ANSWERS - AP Physics C Multiple Choice Practice – Kinematics

	Solution	Answer
1.	$y = \frac{1}{2}at^2$, remember, for horizontal projectiles $v_{oy} = 0$	C
2.	The cars were at the same spot at $t = 0$; we might as well call this the origin. The distance traveled by each during the next 20 seconds is the integral of v with respect to t; it is the area under the curve. Car X has traveled twice as far as Car Y in this time, because the rectangle has twice the area of the triangle.	A
3.	The areas are the same, so each car has traveled the same distance in the 40 seconds. But Car Y is traveling much faster than Car X (higher slope), so it is passing Car X.	B
4.	At $t = 0$, the object is at the origin. At $t = 1$, the object is at (24 m/s)(1 s) = 24 m. The initial speed is 24 m/s. The object is now given an acceleration of $-6\ m/s^2$. At $t = 11$, this is ten seconds after the acceleration begins. That is, reset the clock to zero at $t = 1$. $x = v_ot + \frac{1}{2}at^2$	C
5.	The speed vs time graph values should represent the slope of the distance time graph	E
6.	Since under uniform acceleration x is proportional to t^2, if the object travels 1m in 1 second, it should travel 4 m in 2 seconds. Which means from the time 1 to 2 seconds, the object traveled the additional 3 m.	C
7.	In order to travel directly across a river, the boat's velocity must have a component that cnacels the river's current. In order to do this, the boat must point directly upstream. This leaves no way for the boat to have any component of its velocity across the river and hence, cannot make the trip.	E
8.	$\vec{a} = \vec{V}_2 - \vec{V}_1$	E
9.	$v_y^2 = v_{oy}^2 + 2gy$ where $v_{oy} = v_o \sin\theta$	C
10.	v(t) is the integral of a(t) and x(t) is the integral of v(t). Integrating the given function twice and plugging in the initial conditions gives $x = 2t^3$	B
11.	$a = dv/dt = t$	A
12.	x is the integral of v, which gives $x = 4t + t^3/6$	E
13.	$y = \frac{1}{2}at^2$, remember, for horizontal projectiles $v_{oy} = 0$. Since the cliff is 45 m high, the rocks take 3 seconds to strike the ground. In this time, the rock thrown horizontally travelled 30 m. $v = x/t$	B
14.	$9.8\ m/s^2$ can also be stated as 9.8 meters per second, **per second**	A
15.	average speed = $d/t = (v_o + v_f)/2$	D
16.	velocity of package relative to observer on ground $v_{pg} = v_1 = \searrow$ velocity of package relative to pilot $v_{pp} = v_2 = \downarrow$ velocity of pilot relative to ground $v_{po} = \longrightarrow$ Putting these together into a right triangle yields $v_{pg}^2 + v_2^2 = v_1^2$	D
17.	While the object momentarily stops at its peak, it never stops accelerating downward.	D

18. Maximum height of a projectile is found from $v_y = 0$ at max height and $v_y^2 = v_{iy}^2 + 2gh$ and gives $h_{max} = v_{iy}^2/2g = (v_i \sin\theta)^2/2g$. Fired straight up, $\theta = 90°$ and we have $v_i = \sqrt{2gh}$ — C

Plugging this initial velocity into the equation for a 45° angle ($\sin 45° = \frac{1}{\sqrt{2}}$) gives

$$h_{new} = (\sqrt{2gh}\ \frac{1}{\sqrt{2}})^2/2g = h/2$$

19. horizontal velocity v_x remains the same thorughout the flight. g remains the same as well. — E

20. A velocity-time graph represents the *slope* of the displacement-time graph. Analyzing the v-t graph shows an increasing slope, then a constant slope, then a decreasing slope (to zero) — D

21. For a horizontal projectile, the initial speed does not affect the time in the air. Use $v_{0y} = 0$ with $10\text{ m} = \frac{1}{2} gt^2$ to get $t = \sqrt{2}$ For the horzontal part of the motion; $v = d/t$ — C

22. A velocity-time graph represents the *slope* of the displacement-time graph. Analyzing the v-t graph shows a constant slope, then a decreasing slope to zero, becoming negative and increasing, then a constant slope. Note this is an analysis of the *values* of v, not the slope of the graph itself — A

23. For a dropped object: $d = \frac{1}{2} gt^2$ — D

24. Acceleration is the second derivative of position. — B

25. By process of elimination (A and B are unrealistic; C is wrong, air resistance should decrease the acceleration; E is irrelevant) — D

26. The 45° angle gives the maximum horizontal travel to the original elevation, but the smaller angle causes the projectile to have a greater horizontal component of velocity, so given the additional time of travel allows such a trajectory to advance a greater horizontal distance. In other words given enough time the smaller angle of launch gives a parabola which will eventual cross the parabola of the 45° launch. — C

27. $v = v_o + at$ — C

28. $x = v_o t + \frac{1}{2} at^2$ — E

29. It is the line whose slope is equal to -9.8 m/s^2 (neative and constant) — C

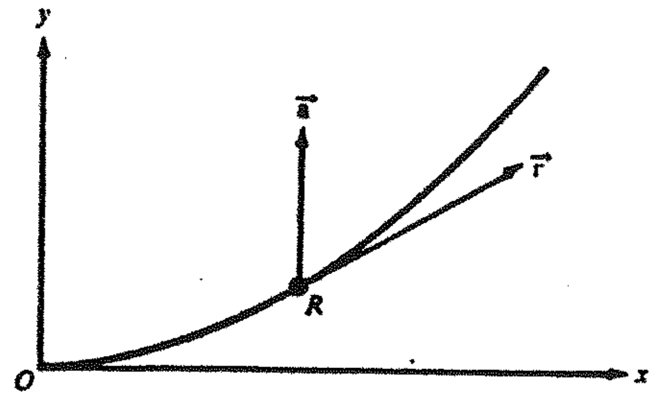
30. $v^2 = v_o^2 + 2gy$ (mass is irrelevant) — B

31. Time to reach maximum height can be found from $v_f = 0 = v_{oy} + at = v_o \sin\theta - gt$. Solve for time to maximum height and double it to find the total time in the air — E

32. $v_1^2 = 2gh$; $v_2^2 = v_1^2 + 2gh = 2gh + 2gh = 4gh = 2(v_1^2)$ — C

1983M1

a) i. The velocity vector is tangent to the path. Since v_x is constant, $a_x = 0$, and the acceleration vector has only a positive y component.



ii. The y component of the velocity is $v_y = dy/dt$, and by the chain rule $dy/dt = (dy/dx)(dx/dt)$ since $y = ½ x^2$, $dy/dt = x$ and $v_y = x(dx/dt) = Cx$

iii. The acceleration is given by $a_y = dv_y/dt$, so $a_y = C(dx/dt) = C^2$

b) i. The speed is given by $v = \sqrt{v_x{}^2 + v_y{}^2}$, by the chain rule, $v_y = dy/dt = (dy/dx)(dx/dt) = xv_x$

so $v = \sqrt{v_x{}^2(1 + x^2)} = \sqrt{\frac{C^2}{1+x^2}(1 + x^2)} = C$

ii. Again the velocity vector is tangent to the path, but since the speed is constant, there is no component of the acceleration along the path, so a is centripetal, perpendicular to v